3. CASE STUDIES OF MAJOR PHC PROJECTS

3.1. Child and maternal health services in rural India: The Narangwal Experiment. Integrated nutrition and health care (Kielmann and Associates, 1983)

The debate over whether various health programmes should be delivered separately, as vertical programmes, or integrated through a general health service delivery system has continued for at least the last 30 years (Mills, 1983). It continues to be in the forefront of policy debates, with arguments over the integration within PHC of programmes such as malaria control, family planning, nutrition and immunization. In the late 1960s, the Narangwal project was set up to examine this and other issues. Since it is also one of the most carefully researched studies of the effectiveness of PHC-type services, and had explicitly a focus on cost-effectiveness, it is an appropriate study to review here.

The questions relevant to economic evaluation posed in the Narangwal study were, "Is there a synergism in programme effects so that a combined programme of nutrition and infection control will have greater impact in cost-effectiveness than would be expected from each programme alone?", and, "Can better field programmes be developed to combine the most cost-effective malnutrition and infection control measures so that they can be implemented within the personnel and financial constraints of developing countries?".

The study was based on an experimental project designed to measure the health effects of interventions targeted at mothers and children. The project area was divided into three, one receiving a package of nutrition care, another health care (mainly infection control) and the third integrated services. The integrated services package was

not just the sum of the separate health care and nutrition packages, since the aim was to compare cost-effectiveness when inputs into each programme were approximately equal. A fourth area with no intervention provided a control. Comparison of the areas was confused by rapid socio-economic development that occurred in the area (the Punjab) during the research; therefore it was stressed that the research findings needed to be adapted and applied in demonstration projects elsewhere.

For the main body of the research a large number of health indicators were monitored. For the cost-effectiveness ratios four indicators of effectiveness were selected, disaggregated by age-group where relevant (Table 3.1). No attempt was made to combine these indicators into one index such as 'healthy days of life added'.

Costs were calculated through a detailed 'functional' analysis which provided information about the cost of each service component and which included as many as possible of project service costs, including donated drugs, food, buildings and land. Capital expenditures were converted to an equivalent annual cost using a discount rate (see Appendix 2). Research and development costs were excluded when considering service provision. Individual and family costs were not taken into account in the cost-effectiveness figures, although use of private practitioners was monitored. In the experimental villages, contacts of small children with private practitioners was about one third of the level in the control villages. The project thus appears to have caused a switch in demand and reduction in household expenditure on private practitioners, though this is not discussed in the study or included as a resource saving accruing to society as a whole.

Average annual cost of services provided per child under 3 years old was about US$23 in nutrition villages, US$21 in

TABLE 3.1

Cost-effectiveness ratios for the three experimental groups, Narangwal

Cost-effectiveness ratio	Experimental group		
	Nutrition plus health care	Nutrition	Health care
	$	$	$
1a Cost per death averted[a]			
Perinatal	9.85	7.75	14.15
Infant	37.35	36.40	25.35
1-3 years	101.45	71.75	30.65
1b Cost per day of illness averted[b]			
Infant	0.56	(c)	0.40
1-3 years	0.39	(c)	0.35
2a Cost per extra cm growth at 36 months[d]	26.25	30.40	(c)
2b Cost per additional percentage point increase in psycho-motor development scores over first 3 years of life[d]	5.05	13.60	(c)

(a) Using a proportion of total programme costs equal to the age-specific mortality rate

(b) Using all health care costs minus costs apportioned to mortality

(c) Small or zero effects produced large or infinite cost-effectiveness ratios

(d) Using all nutrition costs minus costs apportioned to mortality.

Source: Adapted from Table 9.5 in KIELMANN, A.A. & ASSOCIATES. Child and maternal health services in rural India. The Narangwal experiment. Vol 1. Integrated nutrition and health care. Baltimore, Johns Hopkins University Press, 1983.

nutrition and health care villages and US$9 in health care villages. (The price year for costs is unclear, but approximately 1970-73.) The nutrition villages were the most costly per child primarily because a higher average number of child feedings was provided. In addition, integrated services benefited from joint delivery of the two programmes, producing savings in the use of staff time, transport, facilities, drugs and supplies when compared to the cost of providing the two programmes separately.

In order to investigate the cost-effectiveness of different service packages, the costs of service packages in the experimental villages were related to differences in effectiveness measures between experimental and control groups. In order to avoid averaging all costs over the change of each health indicator (resulting in double counting) costs were divided between objectives. (However, the method of doing this was not clearly explained.) A proportion of nutrition and health care costs were allocated to prevention of deaths according to age-specific mortality rates in the control villages. The balance of health care costs was attributed to morbidity reduction, the balance of nutrition costs to improvement of physical growth and psychomotor development. Nutrition costs could not be divided between the two nutrition measures and thus entered into both the nutrition cost-effectiveness ratios.

The cost-effectiveness ratios are shown in Table 3.1. In summary, mortality in infants and children from 1 to 3 years old was decreased with least cost by health care alone, but perinatal mortality was lowered with the least cost through nutrition services. Only health care had an effect on morbidity, and integrated services were most cost-effective for improving growth and development. While a common measurement of benefit could not be found (referred to as the 'unsolved methodological problem'), it was concluded that integrated services produced almost as much nutritional

impact on growth and development as nutrition services, and almost as much impact on morbidity and mortality as health care, for much less than the combined cost of the separate packages. Integration of nutrition and health care services was thus considered to be justified in cost-effectiveness terms.

Given the difficulty of attributing costs to different objectives, it is unfortunate that there was no discussion of whether a change in the method of apportionment might affect the comparison between the objectives or between the service packages. In addition, use of an index such as 'healthy days of life added' might have helped to clarify the comparison between the service packages, even if it would have inadequately reflected nutritional objectives.

To what extent might the results of the study apply elsewhere and could its interventions be afforded elsewhere? While the cost per head of the population was three times as high as the average expenditure of a primary health centre in the Punjab (and the project was targeted only at children under 3 years old), the cost per contact was not dissimilar. The difference in per capita cost was therefore largely due to the higher coverage of the population and the more frequent contacts. The authors of the study suggest that a relatively intense concentration of resources may be required to affect health status, and that the dilution of effort in government services is probably below the threshold level where they can be expected to have any significant effect on health. If project expenditures are compared with total health expenditure elsewhere (public plus private) the discrepancy is somewhat reduced, and the type of health programme of Narangwal is considered realistic if government and community resources could be combined. However, the Punjab is wealthier than many other parts of India and much of the developing world, and more highly trained staff were used (e.g. family health workers with over 2.5 years' training for the home-visiting) than

are likely to be available or affordable elsewhere. There is thus some doubt about the extent to which the Narangwal results suggest PHC strategies which can be afforded elsewhere.

A further question arises over whether the study itself can be replicated. The Narangwal experiment lasted between 1965 and 1973 and the research and evaluation costs were very considerable. Moreover, analysis of the results proved complex, and the final results were not published in book form until 1983. There is an urgent need for methodologies for measuring health impact that are less time-consuming and less expensive. However, the Narangwal study has had a considerable effect on international thinking on PHC, by showing firstly a clear health impact from village-level interventions, and secondly increased cost-effectiveness from integrated services.

3.2. Cost-effectiveness of immunization in the Gambia (Expanded Programme on Immunization, 1982; Robertson et al, 1984; Robertson et al, 1985)

Economic evaluations of immunization strategies are now fairly numerous, and have the advantage that costs and effects are often more easily quantified than in other health programmes. A number of the studies have been performed under the aegis of the Expanded Programme on Immunization (EPI) of WHO and one of these, for the Gambia, has been selected for consideration here. The Gambian study has been selected because the country is a member of the Commonwealth, the medical evidence on the health effects of immunization in the Gambia is relatively good, and there is some helpful information on how costs vary with the level of output.

Immunization services in the Gambia are integrated with the maternal and child health services. Combined services are delivered by teams that work full-time on certain days at

fixed centres and on other days travel to outlying villages and health posts. The immunization schedule includes 4 doses of diphtheria, pertussis, tetanus (DPT) and polio vaccines, single doses of BCG, measles and yellow fever, and four doses of tetanus toxoid for women. The cost-effectiveness evaluation excluded consideration of BCG and yellow fever.

In the cost-effectiveness study (Robertson et al, 1985), the 'effects' were considered to be the cases and deaths averted by each vaccine, and 'costs' the cost to the government of delivering each vaccine. Incidence and case-fatality rates before immunization were estimated on the basis of a number of epidemiological studies, mostly from the Gambia itself. Similar evidence, when available, was used to calculate 'with immunization' incidence and case-fatality rates, supplemented by evidence from cluster surveys of EPI coverage. The difference between cases and deaths with and without the EPI programme constituted the effects of the programme (see Table 3.2).

Costs were estimated in the following way. First, the EPI's share of maternal and child health (MCH) expenditure was calculated, using national data and evidence from visits to a sample of 13 delivery points. Secondly, EPI expenditure (excluding vaccines) was apportioned between diseases on the basis of the number of contacts required for each disease, and the vaccine cost for each disease then added. If multiple vaccines were given at the same contact, delivery costs were divided equally between the vaccines.

The resulting cost-effectiveness ratios are shown in Table 3.3. Measles and pertussis showed the lowest cost per case and death prevented, with neonatal tetanus ranking third, then poliomyelitis and finally diphtheria. Measles, diphtheria and pertussis had very similar costs but radically different cost-effectiveness ratios because diphtheria caused very few cases or deaths in the absence of immunization.

TABLE 3.2

ESTIMATED 1982 DISEASE SPECIFIC MORBIDITY AND MORTALITY IN THE GAMBIA WITH AND WITHOUT IMMUNIZATION

	IF NO IMMUNIZATION		WITH IMMUNIZATION		PREVENTIVE EFFECT	
DISEASE	CASES	DEATHS	CASES	DEATHS	CASES	DEATHS
Neonatal Tetanus	1,333	1,200	414	373	919	827
Measles	25,500	1,224	9,387	451	16,113	773
Diphtheria	30	3	5	1	25	2
Pertussis	24,000	312	6,864	89	17,136	223
Poliomyelitis	100	10	0	0	100	10

Source: Robertson et al (1985)

TABLE 3.3

ESTIMATED COSTS TO PREVENT CASES AND DEATHS
FROM DISEASES PREVENTABLE BY IMMUNIZATION IN THE GAMBIA

(Costs in U.S. Dollars)

DISEASE	COST	CASES PREVENTED	COST PER CASE PREVENTED	DEATHS PREVENTED	COST PER DEATH PREVENTED
Neonatal Tetanus	$125,315	919	$ 136.36	827	$ 151.53
Measles	31,561	16,113	1.96	773	40.83
Diphtheria	22,266	25	890.64	2	11,133.00
Pertussis	22,266	17,136	1.30	223	99.85
Poliomyelitis	65,554	100	655.54	10	6,555.40

Source: Robertson et al (1985)

A number of comments can be made on these findings. First, any resource savings resulting from the EPI programme were ignored. For instance, immunization is likely to have resulted in a reduction in curative treatment. Secondly, the measure 'cases prevented' disguises considerable differences in the nature of the illness episode prevented. This ranges from severe illness with a risk of continuing disability and thus continuing costs of care (e.g. poliomyelitis) through illness which in the Gambia appears to increase the risk of dying from other causes for those children who survive (e.g. measles) to illness which is relatively less severe (e.g. pertussis). Finally, the apportionment of costs between diseases is to some extent arbitrary. Diphtheria appears expensive, but is given as a combined dose (DPT) and its removal from the programme would not result in any significant cost saving. A more relevant approach might have been to assume reduction in tetanus and pertussis to be the main justification for the DPT vaccine, and to distribute costs to these two diseases, regarding reduction in diphtheria as an incidental effect. Looked at this way, the prevention of diphtheria cases and deaths is a 'free' additional benefit, rather than being gained at a high cost.

A more general point concerning the policy implications of the results is that the average cost figures presented do not necessarily provide good estimates of the resources that might be released if one or more vaccines were removed from the schedule. In an immunization programme there are often large shared costs between the vaccines, such as travel by the vaccination team to a health post. Removal of a vaccine is likely to save only the additional variable costs attributable to that vaccine.

The cost-effectiveness ratios presented indicate the ranking of the EPI diseases in terms of cost-effectiveness, but they do not indicate whether it is worth, for instance, spending $6555 per poliomyelitis death averted in comparison to what

might be achieved by using those resources in another programme. This is a general limitation of cost-effectiveness studies, which will be discussed further in Section 4. A rough comparison of the Gambian results with similar results for EPI from other countries, and with results from other programmes, suggests that EPI is cost-effective in terms of cost per death averted when compared with many other health interventions.

The Gambian study thus adds to the evidence that immunization is a 'good buy'. In addition, it provides interesting information on how costs vary with the volume of immunizations provided. The cost per dose and per fully immunized child were calculated for the 13 delivery points investigated (Robertson et al, 1984; Expanded Programme on Immunization, 1982). In general, the cost per dose was inversely related to the average number of doses per session, as shown in Figure 3.1, with no evidence that a minimum average cost point had been reached. The main explanation for this finding is that a substantial proportion of EPI costs are fixed; that is, they do not change as the volume of work increases. Thus the greater the number of doses, the lower are these fixed costs per dose.

These results suggest that steps to decrease the level of fixed costs or increase the volume of immunizations would increase efficiency. Robertson et al (1984) suggest making better use of staff, reducing the frequency of EPI sessions, redistributing catchment areas, and replacing outreach activities by peripheral units. They recognize the dangers of discouraging attendance by requiring users to travel further, but place insufficient emphasis on obtaining information on user time and travel costs. The larger the immunization unit, the larger will be its catchment area and the higher the average time and travel costs to users. When these are taken into account, the optimum volume of

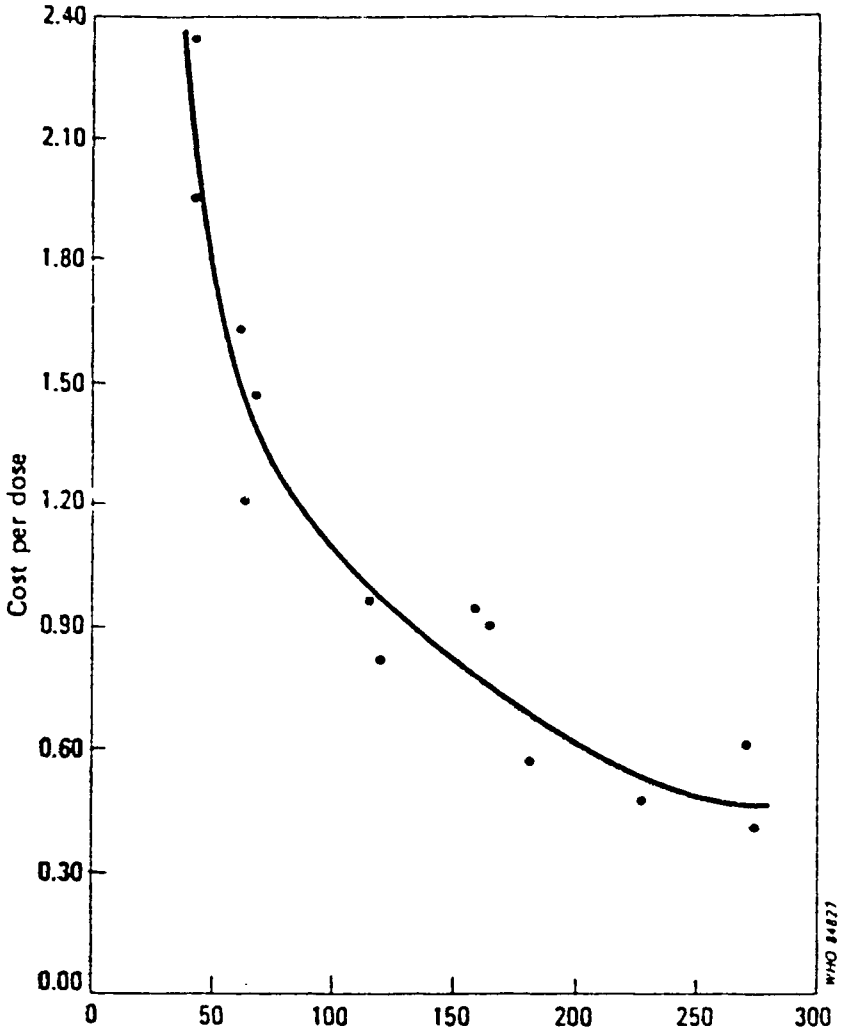

Figure 3.1 Average cost in US dollars per dose, excluding cost of expatriate personnel, in relation to the average number of doses per session (service volume) for the 13 field units, from 1 July 1980 to 30 June 1981.

Source: Robertson et al (1984)

immunizations will be lower than if only provider costs are considered. Robertson et al do not attempt to compare the cost of immunization at a static unit with the cost of the mobile outreach activities from health centres. Their discussion of increasing efficiency through enabling peripheral units to provide immunizations and through saving on the costs of sending health centre staff to these units implies that they expect immunization from fixed peripheral units to be cheaper than mobile outreach activities. This is the reverse of what has been found elsewhere (see, for instance, Creese 1984) and evidence on this issue is required in order to determine appropriate delivery strategies.

3.3 Control of schistosomiasis in St Lucia

The schistosome parasite enters the body of its human host after a period of development in its intermediate host, the water-snail. Humans therefore contract the disease by coming into contact with water inhabited by the snail. In the earlier stages symptoms include lethargy, headache and diarrhoea. More serious organ damage can develop as the infections build up, but the disease is not often a direct cause of death. The parasite's eggs are expelled in the urine or faeces and if this takes place in the snail's habitat the life cycle continues, infecting new individuals and increasing the severity of the disease in those who are already infected.

The economic impact of schistosomiasis has been studied both in Tanzania (Cohen, 1974) and St. Lucia (Weisbrod et al, 1974), where there has been extensive evaluation of control mechanisms through a project financed by the Rockefeller Foundation. Cohen (1974) calculated the per capita benefit from eliminating mortality due to schistosomiasis by using discounted future earnings to value the gain in productive output through extension of working life. Using the assumption (based on an earlier study) that schistosomiasis

reduces life expectancy at birth by 1.8 years, he calculated that the potential benefits were of the same order of magnitude as the per capita expenditure on health of the Government of Zanzibar in 1960. He did not go on to evaluate any particular control strategies, however.

In contrast, Weisbrod et al (1974) argued that there was little evidence that schistosomiasis and the other parasitic diseases studied in St. Lucia were having an effect on birth and death rates, performance of children in school and productivity of adult workers. They found that although schistosomiasis had a debilitating effect which reduced the productive potential for males (as measured by earnings) by a rather substantial 30 per cent, it was having essentially no effect on actual market output as individuals worked more days to minimize the effect of debility on their total weekly earnings.

Weisbrod et al's analysis (of 466 workers on one banana plantation) has been criticized on the grounds that their sample did not include the most seriously debilitated people (who would not have been at work) and that the whole productive environment changes when nearly everyone is sick to some degree. A further deficiency of the initial study, that workers may not have been infected (and reinfected) long enough to display adverse effects, was investigated in a follow-up study (Weisbrod and Helminiak, 1977). Little evidence was found that the debilitating effects of parasitic infection depend on the duration of the infection, although because of migration of workers the sample size was becoming small. Prescott (1979b), in an excellent review article, has outlined the major difficulties in establishing that schistosomiasis seriously impairs labour productivity and the methodological problems with the existing studies.

Despite the uncertainty about the precise social and economic impact of schistosomiasis, in particular its

impact on productivity, its debilitating effects have been considered important enough to institute control measures. In 1965 the Rockefeller Foundation and Government of St. Lucia began a research and control project in which many strategies were evaluated. Most evaluations of effectiveness and cost were of the before-and-after design and were carried out in a number of distinct locations on the island.

The three main options for controlling schistosomiasis examined in St. Lucia were molluscicide programmes to prevent the transfer of the disease, improvement of water supplies to prevent humans from coming into contact with contaminated water and chemotherapy for infected individuals. (In other locations engineering measures, to make drainage and irrigation ditches less hospitable habitats for snails, have been examined.) Clearly these options are not mutually exclusive. In particular, chemotherapy could be used as an adjunct to the other methods of control, and health education could also feature as a component of each. Furthermore, there are choices <u>within</u> the options; for example, a molluscicide programme could be aimed at all snail habitats or at a few 'focal' sites where transmission of the disease is most likely to take place; mollusciciding could also take place more or less frequently. Similarly chemotherapy could be confined only to those found to be infected or could be given to a wider group of the population. In the St. Lucia study molluscicding programmes were concentrated in Cul-de-Sac Valley, provision of improved water supplies in Riche Fond Valley and chemotherapy in Marquis Valley.

The results of the evaluations carried out are shown in Table 3.4. It can be seen that results are reported in terms of annual cost per person protected and cost per case year prevented. The 'case years prevented' is calculated by comparing cases that would occur without control (as

Table 3.4 Economic Evaluations of Schistosomiasis Control Programmes in St. Lucia
(Source: Barlow and Grobar, 1986)

AUTHOR (DATE)	AREA STUDIED	CONTROL METHODS EVALUATED	RESULTS OF ECONOMIC EVALUATION (1984 US $)
Cook et al (1977)	Villages in Marquis Valley, 1974-75	Chemotherapy	Annual cost per person protected: 1974: $2.65 1975: $1.45
Jobin (1979)	Cul-de-Sac Valley	Molluscicides	Annual cost per person protected: $11.14
Jordan (1977)	Cul-de-Sac, Riche Fond and Marquis Valleys, 1973-74	Molluscicides(M) Water Supplies(W) & Chemotherapy (C)	Cost per case-year prevented: $63.02(M) $68.13(W) $14.99(C)
Jordan et al (1978)	7000 people in Cul-de-Sac Valley	Molluscicides	Annual cost per person protected: $5.76
Jordan et al (1982a)	5 villages, Riche Fond Valley, 1977-78	Household water supplies (after transmission reduced by chemotherapy)	Annual cost per person protected: 1977-8: $8.05 1978-9: $9.72 1979-80: $12.35 1980-1: $12.61
Jordan et al (1982b)	10 villages, Marquis Valley	Chemotherapy until 1976	Annual cost per person protected: 1973: $2.91 1974: $1.60 1975: $1.42 1976: $1.45
Prentice et al (1981)	5 communities with total population of 1250, Soufriere River Valley, 1976-80	Monthly application of molluscicides (focal sites)	Annual cost per person protected: $3.75 Cost per case-year prevented: $20.81
Rosenfield (1979)	St Lucia 1970-77	Chemotherapy and water supplies(CW), Chemotherapy(C) Water supplies(W) Molluscicides(M)	Cost per case-year prevented: $33.81(CW) $8.95(C) $41.90(W) $84.23(M)

predicted by a transmission model) with the number of cases that actually occurred over time while the particular control measure or measures were being applied. The difference is the case-years of infection prevented. The general finding is that chemotherapy is the least cost strategy. However, a few critical observations can be made both on study methodology and the results obtained.

First, all the evaluations consider only the direct costs of the control programme to the agency providing it. This means that private costs falling on the local population are ignored and these may differ between options. In particular, most authors note that molluscicide requires no effort on the part of the local population and therefore does not suffer from lack of compliance.

Secondly, the capital costs of programmes, whilst usually included, are not typically handled in the correct manner by calculating an equivalent annual cost using a discount rate, or by identifying capital and recurrent costs by the year in which they fall and discounting these to present values over the expected lifetime of the project (Rosenfield, 1979). (See Section 2.2 and the Technical Appendix for a discussion of this point.) This may in particular affect the comparison of the provision of improved water facilities with the other options, as would assumptions about the expected length of life of the facilities.

Thirdly, no studies attempt to measure the effect on health status of the disease, nor the changes in productive output. As was mentioned earlier, ideally one would want to assess the reduction in quality of life caused by the disease and therefore the gains that could be made by controlling it. Only in this way could one begin to compare investments in schistosomiasis control programmes with those in other PHC activities.

Fourthly, some of the options, in particular the provision of improved water facilities, confer other benefits on the local population (such as time savings and improved quality of life) which in principle should be considered. This suggests that slightly higher costs may be justifiable for the provision of improved water supplies. Alternatively one might argue that it is wrong to attribute all the costs of providing improved water facilities to the schistosomiasis control programme.

Finally, few of the studies consider mixes of strategies. In fact Barlow and Grobar (1986) only identify one study, an unpublished work by Bekele (1980), which addresses this issue in any depth, although Rosenfield (1979) examines a combination of chemotherapy and improved water supplies.

A major issue is that of the generalizability of results from St. Lucia to other settings. In an interesting paper, Jobin (1979) has compared the cost of molluscicide programmes in a number of countries, including St. Lucia. (The main results are shown in Table 3.5.) The conclusion is that costs are generally related to simple geographical parameters such as volume of snail habitat and distance between habitats. In addition rainfall patterns and the cost of chemicals (which varied widely from one location to another) have an impact.

Similarly, the cost of a chemotherapy programme would be influenced heavily by the prevalence of infection, whereas the costs of a water supply programme depend on topography and location of housing. Jobin points out that the villages in the Gezira (Sudan) are well organised and the water table is only 15 metres below the surface; thus water supply should be much less expensive in the Gezira than in St. Lucia, which is a mountainous area with a dispersed population. In particular, some locations would probably require electricity for pumping rather than relying on gravity feed.

Table 3.5 Comparison of Molluscicide Programme Costs for Ten Schistosomiasis Control Projects

(Source: Jobin, 1979)

Country	Puerto Rico			St. Lucia	Brazil			Egypt	Iran	Tanzania
Locality	Vieques	Patillas	Guayama Arroyo	Cul-de-Sac	São Lourenço	Belo Horizonte	Taquarendi	Kom El Birka	Dez Scheme	Misungwi
Hydrology	Natural	Natural and irrigation	Natural and irrigation	Natural	Natural	Natural and irrigation	Irrigation	Irrigation	Irrigation	Natural
Annual rainfall (cm)	115	179	140	250	150	160	50	30	30	100
Controlled area (km^2)	130	122	207	18	80	200	2.5	52	220	100
Population	8,400	17,100	47,000	6,000	4,280	20,000	1,500	17,000	18,000	4,300
Annual volume of snail habitat treated (m^3)	65,000	89,000	106,400	182,000	80,000	39,000	15,000	1,354,000	500,000	200,000
Habitat volume per surface area (m^3/km^2)	500	739	514	10,000	1,000	195	6,000	16,000	2,300	2,000
Population density (persons/km^2)	64	140	227	333	54	100	600	330	82	43
Habitat volume per person (m^3)	7.8	5.2	2.3	30	18.5	2.0	10	80	28	46
Annual cost in 1972 U.S. dollars	$13,000	$17,000	$20,000	$25,000	$32,000	$10,000	$1,500	$58,600	$17,000	$4,178
Annual cost per 100 m^3 treated	$20	$19	$19	$17	$40	$26	$10	$1.40	$3.40	$2.10
Annual cost per km^2	$100	$139	$97	$1,700	$400	$50	$600	$1,130	$77	$42
Annual cost per person	$1.50	$1.00	$0.43	$4.00	$7.40	$0.50	$0.70	$3.45	$0.94	$0.75
Program cost breakdown labor	65%	61%		50%	80%	50%	36%	5%	6%	
Molluscicide	3%	6%	11%	12%	10%	11%	40%	85%	19%	25%
Transport and equipment	7%			16%	5%	15%	24%		21%	
Supervision	22%			16%		24%			54%	
Others	3%	33%	89%	6%	5%			10%		75%

It is therefore possible to begin to identify, from the range of published work, the factors which are likely to affect the costs and effectiveness of alternative control strategies in different locations. These are:

- the dispersion of the snail population;

- the dispersion of the human population;

- the nature of the terrain;

- the stability of, and likely co-operation from, the local inhabitants;

- the level of infection of schistosomiasis in the local population;

- the total cost of chemicals, pharmaceuticals and labour.

3.4 Screening for disease in the developed Commonwealth

In the developed Commonwealth there are not evaluations of primary health care 'projects' in the same way as in the developing countries. Perhaps the closest example to a 'project' in the primary health care field is the nurse practitioner programme established in some Canadian provinces, which was evaluated from an economic viewpoint (Batchelor et al, 1975). However, the normal pattern in the developed countries of the Commonwealth is for the range of activities in primary health care to expand or change as medical knowledge progresses. Therefore, for the final case study we have selected a topic area, screening for disease, rather than a project, in order to illustrate what can be learned from the economic evaluation of PHC activities in developed countries. Screening has been chosen since there is a

sizeable economic evaluation literature from a number of countries and because this is one area of medicine that the developing countries in the Commonwealth may increasingly consider as their income per capita rises. Indeed, since one of the economic arguments for screening is that it saves more resources than it consumes, it may be one PHC activity that some are actively considering now.

It can be seen from the review of the literature in developed countries (Section 2.1.2) that screening activities have been a popular topic for economic evaluation. The basic choice is between screening and treating the disease at the asymptomatic stage, or waiting until symptoms develop and then employing a curative approach. These were the options examined by Pole (1971) in the case of tuberculosis in Britain. The usual economic logic for screening is that a 'stitch in time saves nine'; that is, the costs of letting the disease progress may far exceed the costs of screening and early intervention. In a recent review, the Health Economics Research Unit of the University of Aberdeen (1985) spells out in more detail the kinds of questions economic studies have sought to answer, namely:

- would screening produce a net saving of health service resources? (and if not, what would be the net cost?)

- would screening produce a net saving of society's resources? (and if not, what would be the net cost?)

- would the value of all the benefits of screening (both tangible and intangible) exceed the value of all the costs (both tangible and intangible)?

- what would be the cost per life year (or per quality-adjusted life-year) gained by screening?

- what would be the least costly method or strategy of screening for some disease?

- what would be the most effective way of spending a given budget on screening for some disease?

- what would be the extra costs of obtaining greater screening effectiveness?

Our literature review has identified 16 economic evaluations of screening programmes undertaken in Commonwealth countries. Many of these were mentioned in Section 2.1.2. above. The main results of the studies are summarized in Table 3.6. In the discussion below a number of general lessons are drawn.

Which individuals to screen?

One of the main issues in mounting a screening programme is the choice of the population to screen. Most of the literature distinguishes between programmes for the general population and those for people of high risk. The features that delineate high risk individuals will differ from disease to disease, but are usually related to age or sex, previous family history of the disease, or likely exposure due to place of residence or lifestyle.

It is obvious that the costs and benefits of the screening programme will be highly dependent on the prevalence of the disease in the population screened and an economic approach to screening would usually seek to devise guidelines for who should be screened. For example, in Britain the screening of pregnant women for Down's syndrome and screening for cancer of the cervix are both advised for older age groups. However, whereas guidelines may state that screening should be restricted to high risk groups it may be difficult to enforce these in practice.

Table 3.6 Economic Evaluations of Screening for Disease in the Developed Commonwealth

AUTHOR (DATE)	COUNTRY	PROGRAMME(S) EVALUATED	MAIN RESULTS
Pole (1971)	Britain	Mass miniature radiography	Benefits amount to only 50% of costs
Webb et al (1973)	Canada	PKU screening in newborns	Costs of identifying and caring for a child through screening much less than the costs of institutionalization
Thorn et al (1975)	Britain	Screening for cancer of the cervix	Costs of detecting and treating each pre-clinical case were less than that of inpatient treatment of each clinical case
Hagard and Carter (1976)	Britain	Prenatal diagnosis of Down's syndrome	Potential economic benefits were greater than, or equal to, the costs for women aged 35 and over
Hagard et al (1976)	Britain	Prenatal diagnosis of spina bifida	Screening would only be worthwhile on economic grounds in populations where the incidence is high. However, other factors need to be considered
Rich et al (1976)	Britain	Two methods of screening school children for asymptomatic bacteriuria	An unsupervised test was cheaper but did not give good yields for low income groups
Simpson et al (1978)	Britain	Alternative screening test combinations for breast cancer	The choice of test depended crucially on judgements about the value of the screen outcomes and not just on sensitivity, specificity and cost of the tests
Komrower et al (1979)	Britain	PKU screening in newborns	Net health service resource saving
Veale (1980)	New Zealand	PKU screening in newborns	Averted health service costs were greater than the costs of screening under most assumptions
Logan et al (1981)	Canada	Screening and treatment for hypertension	Treatment at the worksite was more cost-effective than treatment by physicians in the community
Henderson (1982)	Britain	Screening for open spina bifida	Tangible benefits of the programme probably exceed the tangible costs by about £1m per 100 births averted per year
Gravelle et al (1982)	Britain	Alternative combinations of screening tests for breast cancer	Mammography (with the result read by a senior radiologist) was the most cost-effective option in terms of net health service cost per life year gained
Mooney (1982)	Britain	Alternative ways of screening for breast cancer	Mammography plus one clinical examination was the most cost-effective option
Henderson et al (1984)	Britain	Screening for cogenital toxoplasmosis	Screening would be unlikely to save resources except under the most optimistic assumptions
Hibbard et al (1985)	Britain	Five options for screening for open neural tube defects	Ultrasound plus amniocentesis (where indicated) was the most cost-effective approach. Screening would cost £7000 per birth averted at an incidence of 25/1000
Williams (1985)	Britain	Screening for syphilis during pregnancy	The benefits in cost savings to the NHS were an order of magnitude greater than the costs of the programme
Medley and Drake (1982)	Australia	Screening for cervical cancer	Two avenues can assist in reducing the costs of screening; by reducing the population screened or the frequency of smears; or by simplifying sample collection, through the use of paramedical staff operating from caravans. However, any reductions in cost need to be balanced by effectiveness considerations

For example, in the case of screening for cancer of the cervix in Britain, general practitioners receive payment only for Pap smear tests performed at 5 yearly intervals and on older women. Nevertheless, few doctors are likely to turn away a patient not meeting these criteria but who would like to be screened. Indeed one might argue that reassurance of well women is a legitimate economic benefit; however, since most screening tests have false positives and false negatives associated with them, the reassurance from a true negative result has to be balanced against the distress and further testing which may follow a false positive.

How often to screen?

The issue of frequency of screening was mentioned above. Clearly an optimum policy would need to consider the likelihood of detecting disease at different intervals, based on what is known about its aetiology. To our knowledge no economic evaluations undertaken within the Commonwealth address this issue. The best work is that by Eddy (1980) in the USA, who has analyzed the question of frequency for a variety of cancer screening tests. For example, using the best clinical information on the natural history, detection and treatment of cervical cancer, he found that administering Pap tests to adult women every three or four years would produce almost as much health benefit, measured in years of life saved, as administering them every year, and at less than a third of the cost. It has been argued that the preclinical course of cervical cancer is so long that, even with tests only every three or four years, the disease can be detected long before it would become clinically apparent (Russell, 1986). It can be seen that the economic conclusions in this field are crucially dependent on the underlying epidemiological data, which are often themselves in dispute. Unfortunately there are few randomized controlled trials of screening programmes. The

study by Cadman et al (1986) on developmental screening of school children in Ontario (Canada) is one of the few examples.

The issues of 'whom to screen?' and 'how often to screen?' illustrate one of the fundamental points in economics, that decisions depend on costs and benefits at the margin. That is, it is often not a question of whether a particular programme is worthwhile, but how much of it would be worthwhile. (For more discussion of this point see the general methodological discussion in Appendix 2).

Which test to use?

There are often choices among screening tests or the order in which they are applied. For example, should one use a cheaper, less accurate test initially, or go straight to the accurate 'gold standard' test which may be more expensive to apply but which may turn out cheaper in the long run? There are few studies in this field, but Simpson et al (1978) examined 15 alternative screening test combinations for breast cancer in Britain. They considered the health service resource use arising from the different options and the more intangible costs and benefits arising from test results (e.g. true positive, false positive, etc.) The authors did not intend to recommend a particular course of action, but did point out that the choice of test was crucially dependent on judgements about screening outcomes and not just on the conventional criteria such as sensitivity, specificity and cost. This is one area where more work is required and there are plans to investigate the utility to women of test outcomes in the choice between chorion villus sampling and amniocentesis in Canada (Fuller et al, 1985).

Another dimension to the choice of screening test is the possibility that once a basic screening programme has been mounted various kinds of 'add-ons' will be proposed. Veale (1980) warned against this in his economic evaluation of screening for phenylketonuria (PKU) in New Zealand. Whilst concluding that the benefits of screening justified the costs, he stressed that other elements of screening should not be added without economic evaluation. Presumably the fear is that once the first screening programme is mounted the tendency is for health professionals to argue that the marginal costs of adding other components to the programme are small. In many situations this may be the case, as has been shown in some of the evaluations of immunization programmes (see Section 3.2 above). However, policy makers should be alert to these arguments and request empirical evidence to justify the addition. For example, in Britain Hagard et al (1976) argued that ultrasonography should be a component of a screening programme for the antenatal detection of neural-tube defects (such as spina bifida) as it would confirm gestational age in women who were 'unsure of dates'. Subsequent analysis by Glass (1979) questioned whether the additional case finding, which was small, would justify the extra costs.

Will there be compliance with the screening programme and the subsequent therapy?

Another 'add-on' proposed by Hagard et al (1976) in their screening programme for antenatal detection of neural tube defects was a publicity campaign to ensure high compliance with the screening programme by women and their family physicians. Compliance is often a major problem in the screening field since the individual is not suffering any discomfort at the time. Certainly Roberts et al (1983) found a much lower compliance rate with their programme as

applied in practice in South Wales, than that assumed by Hagard et al (1976).

In addition there may be problems of compliance with the therapy required after the detection of disease by screening. As mentioned earlier, termination of the pregnancy raises moral issues which will affect compliance. In other fields, such as hypertension, the side effects of therapy may cause patients to discontinue it. Weinsten and Stason (1976) pointed out that in the USA there may be greater economic benefits from developing methods to ensure compliance with therapy in already known hypertensives than further extending screening programmes to discover yet more hypertensives. The cost-effectiveness of a compliance-improving manoeuvre in hypertension using a specially trained member of the lay public has been examined by Mitchell et al (1983) in Canada. They found that the intervention did represent a worthwhile investment, in cost per mmHg of blood pressure reduction, when compared to other similar interventions.

How equitable should screening programmes be?

The discussion so far has been solely concerned with economic efficiency. However, there are other important dimensions of public policy, such as equity or fairness in the provision of health programmes. For example, is the programme available for all those whom could potentially benefit? Of course, equity may come at a price, in terms of reduced efficiency, and this was illustrated by a study of screening for asymptomatic bacteriuria in schoolgirls in Britain (Rich et al, 1976). They found that the most efficient test (in terms of cost per case detected) did not detect a very high proportion of cases in the lower socio-economic groups. (It was an unsupervised test that required a high level of understanding and cooperation by the children and their parents.) The authors therefore

pointed out this difficulty and suggested to policymakers that if equity criteria were important, perhaps a slightly more costly supervised test should be used. The same basic issue has arisen in the evaluation of some immunization programmes in the developing Commonwealth (Ponnighaus, 1980). On efficiency grounds one would not advise measles immunization in rural areas without a reliable electricity supply. On equity grounds one might be prepared to accept the lower cost-effectiveness of an extension of the immunization programme to such areas.

What actions can governments take in this area?

Despite the comments made above about lack of compliance by physicians and the general population, in principle screening programmes lend themselves to government action since they often require a coordinated effort with large resource commitments. The kinds of policies governments can develop mirror the choices outlined above; namely, to issue guidelines on:

- what diseases to screen for;

- which population(s) to screen;

- how frequently to screen;

- which screening test(s) to use?

These guidelines may be backed up by financial measures, such as providing funds to support only those activities in accordance with the guidelines or reimbursing physicians only for screening tests in conformity with the guidelines. As far as we know, the extent to which government policies in this field are based on economic evaluation is slight. There are some indications that in Britain economic analysis had some input to the derivation

of the policies on screening for spina bifida cystica and tuberculosis, although Pole's study of mass miniature radiography was carried out after a decision to discontinue the programme had been taken. More recently, however, the DHSS Working Party on breast cancer screening has economist input and the terms of reference for the Working Party include an obligation to examine the costs and benefits of alternative screening policies.

Our general conclusion is that if health ministries are to obtain more benefit from the economic evaluations that are carried out, they need to ensure that good methodological standards are maintained, that mechanisms exist for interpreting the results of studies for policy makers and that policy instruments exist to enable action to be taken on the basis of evaluation results. These issues are discussed in Section 4 below.